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WHAT COLOR IS SAPPHIRE

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FOREIGN TECHNOLOGY DIVISION



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WHAT COLOR IS SAPPHIRE ?

Travels into the World of Science

G. Alov

Rose, lilac, green garnets, alexandrites, changing their color depending on the light, sapphires... They sparkled, reflecting the rays of the sun with countless facets. They were shown to me by Doctor of physicomathematical sciences Kh. Bagdasarov - supervisor of the laboratory of high-temperature crystallization of the Institute of Crystallography AS USSR (ICAS). These were precious and semi-precious stones grown by humans. In many respects they are better than natural stones.

When "stone flowers" were the only measure of eminence and wealth, alchemists tried to obtain them synthetically. But at the level of science and technology existing at that time it was impossible to imitate the natural processes of which high pressures and temperatures are characteristic. This could only be done at the level of our century.

Scientists who synthesize and grow minerals call themselves cultivators. They are mathematicians, physicists, chemists, mineralogists, and petrographers. Crystallography which is a combination of these sciences also includes within itself a number of technical

disciplines, among them radio engineering and radioacoustics. By its own doctrine of symmetry, crystallography has long since influenced graphic art and architecture. It is no coincidence that in Georgia on the pediment of a temple where the remains of the Bagratians lie, an ancient architect erected a hand with a crystal clutched in it.

Today in technology, refractory and heatproof materials are being used more and more. Among these are precious stones. Only diamond is not one of these. At the time when we still did not know that it is one of the modifications of carbon, there was the following case: diamond together with emerald, sapphire, ruby, alexandrite, and precious spinel were dropped into a crucible. Under the effect of an increased temperature the diamond was transformed into a light puff of smoke. But the gems remained untouched.

The digression into history stops suddenly with the report that the cycle is about to end and it will possibly assist in the creation of an alternate sapphire.

In concept this stone subjugates any man with its dark blue color which resembles a southern night sky. But the "new-born" sapphire which I saw was colorless. However, this did not detract from its quality at all. It was really not created for jewellers at all. For example, on its fine blades and plates an integral design is drawn. A current passes only across it, for synthesized sapphire is an excellent dielectric.

Artificial sapphire is inferior only to diamond in hardness. Any acids and alkalis do not harm it. It endures even sodium and lithium vapors well. Specialists also admire its optical properties and its ability to oppose not only high pressures and temperatures but also hard radiation. This is understood as follows: radiation does not produce a change in its properties. But this still is not all: sapphire is very convenient for technologists - it can be welded with glass and soldered to metal.

In my presence a four-kilogram crystal was removed from a molybdenum "boat" which emerged from the crystallization set-up. With a diamond instrument a fine, small circle was cut out of it which was inserted into a double ring made from steel and copper. From a high frequency generator this "eyelet" emerged as soldered with the metal for good. By this same method they also produce large illuminators which make it possible to follow the process occurring in devices and apparatus where vacuum, high temperatures and pressures reign. The imagination can picture a bathyscape with sapphire illuminators which endure the pressure of water at great depths. Incidentally, it is completely natural that, not dark blue, but namely transparent, colorless sapphire is needed for similar purposes.

At times man creates that which ingenious nature did not. A four-kilogram sapphire crystal deprived of impurities is a unique phenomenon. A collective of a laboratory studied for ten years to grow these "giants". They began by obtaining crystals 200-300 grams in weight. They developed a new technology. For this they needed more perfect equipment. The staff of a special structural bureau of the Institute of Crystallography in close collaboration with the laboratory created a crystallization set-up which was made a commercial-type. It can be seen in a number of ^{the} country's enterprises which apply the technology developed at the ICAS.

The new technology was already created and proved its value under production conditions. The collective of the plant "Emitron" synthesized a halfpood sapphire which was round in shape with a diameter greater than a hundred millimeters.

Colorless garnet was raised to the pedestal of honor following sapphire. From it one can even make strasses - imitation of diamonds. One must be a very great specialist in order not to take a strass with fifty seven classic facets for an original diamond of first water. But is this worth discussing since colorless garnet has a completely different special purpose?

First of all it gained a victory over ruby since it acquired widest application in the clock industry and then in quantum generators. When it was revealed that garnet surpasses ruby with its properties it held a place in lasers.

Unlimited possibilities are open before the cultivators. Based on the ideas developed by the laureate of the Lenin prize, academician N. Belov, they designed new compositions which were expressed by crystals with valuable properties. Examples of these are colorless sapphire, garnet, and also transparent mica which radiotele-engineers value more than natural mica by far.

~~This also can be said of synthetic quartz and jewelry stones~~ obtained by the hydrothermal method at the All-Union Scientific Research Institute of the Synthesis of Mineral Raw Materials of the Ministry of Geology of the USSR (ASRISMR). Here is where the students of N. Belov work. One of them - Vladimir Petrovich Butuzov. He is a Doctor of physicomathematical sciences, professor, and director of the institute. Under his supervision they found the best means of growing quartz, diamond, mica, and other scarce materials which are acutely needed in the various branches of industry.

Among the jewelry stones synthesized by the workers of the ASRISMR amethyst occupies a special place - a violet modification of quartz. Under the conditions of nature milleniums must pass for this "violet" to be created. It was considered impossible to synthesize amethyst. This was done for the first time by our country. Because of the intensity of its color and reddish gleam flashing in its depths even under electric lighting, it surpasses not only Brazilian and Ceylonese amethysts but also the unique Uralian amethysts.

Synthetic violet crystals are distinguished by their special purity. They have one additional merit: they do not lose their color under the effect of direct rays of the sun. What is more,

even with respect to ^{their} size the artificial stones surpass natural ones: a crystal thirty centimeters in length stands out among faceted amethysts of various sizes.

Already last year in experimental production at the institute they obtained amethysts of higher quality than those obtained over the last decades in the world.